



Assessment of Heavy Metals in Water Samples of Certain Locations Situated Around Tumkur, Karnataka, India

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Abstract: Surface water and groundwater samples of certain locations namely Kallambella, Bugudanahalli, Maidala, Honnudike, Kunigal, Kadaba and Hebbur, situated around Tumkur were assessed in the month of September 2008 for pH, EC and heavy metals Cd, Cu, Fe, Hg, Mn, Zn and Ni. The pH values of surface waters were in alkaline range of 7.8-8.2 and are well within safe limits for crop production. The pH of groundwater was in the range of 7.6-8.4. The conductivity was in the range of 0.20-0.68 mS/cm and 0.34-2.44 mS/cm for surface and groundwaters respectively. High EC value of Kallambella groundwater accounts for its salinity. All surface waters except Honnudike and Hebbur samples contain low concentrations of these metals and are ideal for irrigation. Though the samples from Honnudike, Kadaba and Hebbur have high iron concentration, only Honnudike and Hebbur samples have exceeded the limit of 5 mg/L required for irrigation. In groundwaters the concentrations of all these heavy metals except copper are also well in permissible limits and suitable for drinking. Cu, Fe, Ni and Zn were detected in all the samples and found in the range of 0.094-0.131, 0.958-12.537, 0.020-0.036 and 0.082-1.139 mg/L respectively in surface waters and these are in the range of 0.132-0.142, 0.125-1.014, 0.028-0.036 and 0.003-0.037 mg/L in groundwaters. The elements cadmium, mercury and manganese are absent in all the samples.

Keywords: Surface waters, Groundwaters, Heavy metals, Irrigation.

Introduction

Heavy metals are environmentally stable and non-biodegradable, toxic to the living beings and tend to accumulate in plants and animals causing chronic adverse effects on human health. Heavy metals are introduced to the environment through a variety of sources such as combustion, extraction, agricultural runoff, transportation *etc*¹. Heavy metals are priority toxic pollutants that severely limit the beneficial use of water for domestic and industrial application². Frequent use of heavy metal contaminated water in the agricultural fields leads to soil pollution and gradually enriched the soil with heavy metals. Different studies have revealed that the presence of toxic heavy metals like Fe, Pb, Hg reduce soil fertility and agricultural output³. The lakes have complex and fragile ecosystem, as they do not have self cleaning ability and therefore readily accumulate pollutants⁴.

Though some of the metals like Cu, Fe, Mn, Ni and Zn are essential as micro nutrients for plants and microorganisms, many other metals like Cd, Cr and Pb are proved detrimental beyond a certain limit⁵. With sufficient surface water infiltration, soil contaminants such as heavy metals can leach to underlying groundwater. The effects of heavy metals on groundwater are different for different types of soils⁶. Occurrence of heavy metals in groundwater were directly related to soil characteristics that determine the rate of water movement⁷. According to WHO⁸, copper is rarely found in natural water, consequently its existence in high concentration in waters within the area of study is an index of pollution from leachates and effluents of the polluted environments where the water sources are located.

Experimental

A total of 14 water samples (7 surface water samples and 7 groundwater samples) were collected from lakes and nearby hand pumps of the selected areas around Tumkur namely Kallambella, Bugudanahalli, Mydala, Honnudike, Kunigal, Kadaba and Hebbur and preserved with 2 mL nitric acid to prevent the precipitation of metals. The samples were then concentrated and subjected to nitric acid digestion. Heavy metal analyses were carried out using inductively coupling plasma method. The pH of water samples was determined by a pH-meter and conductivity was measured by a conductivity meter (Systronics).

Results and Discussion

Surface waters

The surface waters exhibited an alkaline pH range of 7.6-8.2 but the values are well within the safe limit of crop production⁹. Higher levels of pH and alkalinity tend to reduce toxicity of metals in water¹⁰. The most influential water quality parameter on crop productivity is the water salinity hazard as measured by electrical conductivity. The primary effect of water having high EC on crop productivity is the inability of the plant to compete with ions in the soil solution for water. The higher the EC, the less water is available to plants, even though the soil may appear wet. Water with electrical conductivity less than 0.7 mScm⁻¹ is considered to be safe but in the range of 0.7-3 mScm⁻¹ may cause little to moderate salinity problems¹¹. However in the present study, the conductivity values of waters are in the range of 0.20-0.68 mS/cm and are suitable for crop production. The analysis of surface waters for Cd, Fe, Cu, Hg, Mn, Zn and Ni revealed that all the samples, except Honnudike, Kadaba and Hebbur samples have very low concentrations of these elements and are suitable for irrigation. However, the samples from Honnudike and Hebbur have more Fe concentration and exceeded the limit of 5mg/l required for irrigation waters¹². Though Kadaba waters have excess iron concentration, the value is well in limit of 5 mg/L (Table1).

Table 1. pH, EC (mS/cm) and Concentrations of heavy metals (mg/L)

Locations	pH	EC	Cd	Cu	Hg	Fe	Mn	Ni	Zn
Kallambella	8.2	0.34	Nil	0.095	Nil	3.994	-0.066	0.032	1.139
Bugudanahalli	8.0	0.20	Nil	0.120	Nil	0.958	-0.148	0.021	0.082
Mydala	7.6	0.44	Nil	0.113	Nil	0.992	-0.144	0.021	0.140
Honnudike	8.0	0.68	Nil	0.094	Nil	9.783	-0.092	0.026	0.263
Kunigal	7.8	0.22	Nil	0.131	Nil	1.057	-0.139	0.020	0.222
Kadaba	7.9	0.28	Nil	0.118	Nil	2.038	-0.146	0.024	0.391
Hebbur	7.8	0.26	Nil	0.118	Nil	12.537	-0.123	0.036	0.744
FAO	-	-	-	0.2	-	5.0	0.2	0.2	-

Groundwaters

The groundwaters also have the alkaline pH range of 7.6-8.4 and the values are well within the safe limit for drinking¹³. These waters have the conductivity range of 0.34-1.86 mScm⁻¹. The analysis of heavy metals in these waters have revealed that (Table 2), except Cu, the concentrations of all other elements namely Fe, Zn and Ni are within the safe limit for drinking set by BIS¹⁴. The low concentration of zinc in drinking water could be due to the fact that pH of water samples were slightly alkaline and its solubility is a function of decreasing PH¹⁵. Low intake of zinc results in growth retardation, immaturity and anemia¹⁶. The relative dominance of heavy metals in all the samples are in the order of Fe>Cu>Zn>Ni except for the samples from Kunigal, Kadaba and Hebbur where the order is Fe>Cu>Ni>Zn. The concentrations of Fe varied from 0.125 to 1.014 mg/L, Cu from 0.132 to 0.142 mg/L, Ni from 0.028 to 0.036 mg/L and Zn from 0.003 to 0.051 mg/L. The Fe concentration of Bugudanahalli water is slightly exceeding the drinking water limit of 0.3 mg/L set by BIS, 1991. Long term consumption of drinking water with high concentration of iron may lead to liver diseases¹⁷. All the samples have higher Cu concentrations and exceeding the limit of BIS value, 0.05 mg/L for drinking. Though copper is not a cumulative systemic poison, large dose(>1.0 mg) is harmful and might cause central nervous system disorder, failure of pigmentation of hair and effects on Fe metabolism¹⁸.

Table 2. pH, EC (mS/cm) and concentrations of heavy metals (mg/L)

Locations	pH	EC	Cd	Cu	Hg	Fe	Mn	Ni	Zn
Kallambella	8.4	2.44	Nil	0.132	Nil	0.274	-0.159	0.030	0.037
Bugudanahalli	7.8	0.66	Nil	0.136	Nil	1.014	-0.156	0.028	0.029
Mydala	7.6	0.34	Nil	0.139	Nil	0.242	-0.159	0.036	0.051
Honnudike	8.3	1.68	Nil	0.142	Nil	0.683	-0.192	0.028	0.048
Kunigal	7.8	0.62	Nil	0.142	Nil	0.125	-0.156	0.031	0.012
Kadaba	7.9	0.58	Nil	0.137	Nil	0.128	-0.159	0.031	0.015
Hebbur	7.6	0.92	Nil	0.142	Nil	0.130	-0.156	0.034	0.003
WHO, 1971	-	-	0.01	1.0	0.001	1.0	0.5	-	5.0
BIS, 1991	-	-	0.01	0.05	0.001	0.3	0.1	-	5.0

Conclusions

All the surface water samples except samples of Honnudike and Hebbur were found to be having normal concentrations of heavy metals and fit for irrigation purpose. However, Hebbur and Honnudike samples have iron concentrations exceeding the limit set for irrigation purpose.

All the groundwater samples under study have normal concentrations of iron and nickel, lower concentrations of zinc, and higher concentrations of copper. Cadmium, mercury and manganese are found to be absent in all the samples.

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